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EVAPOTRANSPIRATION FROM BARE SOIL AND PARTIAL CROP COVER

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Bare Soil

Making further use of the Cranwell analysis of bare soil evaporation on the lines of Ag.Mem.586, a simple expression was found for the April evaporation from bare soil (heavy soils), expressed as a percentage of potential transpiration.

$$\frac{100.E}{P} = 72.6 + 2.8D_2 - 1.23L$$

where D_2 is the number of days with 2 mm or more of rain (Mar.31 - April 29)

L is longest dry spell between such days in the month

The multiple correlation is 0.89 and mean error 3.1 mm; nearly 90% of the estimates are within 5 mm of the calculated evaporation.

Partially covered soil

It is now possible to estimate the evapo-transpiration (ET) from partially covered soil over 10 day periods.

Using

D_2 = number of days with 2 mm of rain or more within the 10 day period

L^1 = length of dry spell in April ending during (or at the end of) the 10 day period.

Then the percentage ratio of ET to potential transpiration was given by the following equations:-

Bare Soil	$70.8 + 10.4\ D_2 - 1.93\ L_1^1$
20% cover	$76.6 + 8.4\ D_2 - 1.55\ L_1$
40% cover	$82.1 + 6.3\ D_2 - 1.12\ L_1$
60% cover	$88.1 + 4.26D_2 - 0.77\ L_1$
80% cover	$94.0 + 2.15D_2 - 0.37\ L$

The following degrees of accuracy were obtained.

	Mean Error	Percentage with $\pm$ 2 mm
Bare soil	1.5 mm	80
20%	1.2 mm	83
40%	1.0 mm	93
60%	0.7 mm	97
80%	0.3 mm	100

The regression coefficients alter in a near-regular manner. Therefore if C is the percentage crop cover, a close approximation to all equations is

$$70 + \frac{3C}{10} + (10.3 - \frac{C}{10})\, D_2 - (1.95 - \frac{2C}{100})\, L^1$$

This equation was tested against Goole data, with the following results.

	Mean Error	Percentage within $\pm$ 2 mm
Bare soil	1.8 mm	77
25% cover	1.2 mm	90
50% cover	0.8 mm	97
75% cover	0.3 mm	100

the majority of the errors being on the negative side.

The generalized equation seems therefore fit to use in practice.
It is interesting to note that if C = 100, this equation becomes

$$100 + 0.3\, D_2 - 0.05\, L^1$$

which is not going to differ greatly from the obvious answer of 100, whatever the values of D_2 and L^1. If D_2 is high it will even take into account the direct evaporation from drops of water, which is greater than the transpiration!

The equivalent equation for light soils (containing only 2 mm per layer) is

$$49 + \frac{5C}{10} + 12\,(1 - \frac{C}{100})\, D_2 - 1.35\,(1 - \frac{C}{100})\, L^1$$

which gives the following errors on Cranwell data.

	Mean Error	Percentage within $\pm$ 2 mm
Bare soil	1.5 mm	77
40% cover	0.8 mm	87
80% cover	0.2 mm	100

Using these two generalized equations it is now a simple matter to draw up contingency tables of percentage of potential transpiration for any C, using the variables, D_2 and L^1.

Any comments or suggestions on this paper should be referred to the author.

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